

REMARKS

Claims 1–13 and 15–31 are currently pending in the application. In the above amendment, Applicants' representative has amended claims 1, 3-7, 9-13, 15, 20-24, 26-30 to more distinctly and clearly claim that which Applicants regard as their invention. In an Office Action dated January 13, 2005 ("Office Action"), the Examiner rejected claims 1–12 and 20-25 under 35 U.S.C. § 103(a) as being unpatentable over Sparks et al., U.S. Patent No. 5,212,784 ("Sparks") in view of Beier et al., U.S. Patent No. 6,065,018 ("Beier"), rejected claims 7-12 and 26-31 under 35 U.S.C. § 103(a) as being unpatentable over Sparks in view of Beier and further in view of Sakuraba et al., U.S. Patent No. 5,452,448 ("Sakuraba"), rejected claims 13 and 15-17 under 35 U.S.C. § 103(a) as being unpatentable over Carter et al., U.S. Patent No. 5,909,540 ("Carter") in view of Beier, and rejected claims 18–19 under 35 U.S.C. § 103(a) as being unpatentable over Carter in view of Beier and further in view of Mutalik et al., U.S. Patent No. 6,161,111 ("Mutalik"). Applicants' representative respectfully traverses these 35 U.S.C. § 112 and 35 U.S.C. § 103 rejections, for reasons provided below.

First, Applicants' Representative would like to respond to the Examiner's Response to Arguments section of the Office Action. Applicants' Representative well understands that limitations may not be imported from the specification to the claims. For example, were a specification to provide embodiments of a device in all of which a highly specialized screw of non-standard length, non-standard width, non-standard thread-pitch, and non-standard alloy composition is used, and in which correct functioning of the claimed device depends on that particular type of non-standard screw, the applicant could not use the general term "screw" in a claim, and then later argue that the general term "screw" means the non-standard screw with a non-standard length, non-standard width, non-standard thread-pitch, and non-standard alloy composition. In other words, an applicant cannot use a broad term in a claim that is not specifically defined in the specification, and then argue that the term has a more narrow definition because of limitations recited in the specification.

However, while an applicant cannot import limitations into the claims from the specification, an applicant can most certainly use terms and phrases in the claims that have well-known meanings to those skilled in the art, or that are defined in

the specification, fully relying on an interpretation of those terms and phrases in the claims consonant with the definitions of the terms and phrases in the specification or the well-understood meanings of the terms and phrases held those skilled in the art. For example, if an applicant uses the word "nail" in a claim, applicant can rely on that word not be expanded to meaning a screw, clamp, glue, or other fasteners. As another example, if an applicant uses the word "automobile" in a claim, the applicant can rely on that term being interpreted as a car, and not a submarine, airplane, or horse. Otherwise, claims would become encyclopedic, and necessarily exceed, in length, the detailed description of the invention sections which are supposed to support them, which themselves would grow to absurd lengths.

The Examiner's Response to Arguments section indicates confusion on this point. For example, the Examiner states: "Second, the logical device units are not define[d] in the claim, the claims are interpreted in light of the specification, limitation from the specification are not read into the claim . . ." Applicants are in no way obligated to define each term of a claim within a claim. This is precisely what the non-claim portions of the specification are intended to do. The terms "logical unit" and "logical device" are extremely well-known to those familiar with computer hardware, as are the terms "mass-storage device," "disk-array controller," "timestamp," and many of the other terms and phrases used in the current claims. Moreover, a lengthy and detailed background of the invention section and detailed description of the invention section either define these terms and phrases or provide example embodiments in which these terms and phrases are used consistently with their meaning in the computer arts. For example, reliance on the fact that the phrase "mass-storage device" refers to a device that stores electronic data on one or more non-volatile data-storage media, such as hard disks or optical disks, and that the term "mass-storage device" does not include a volatile, random-access memory in a computer system is fully justified both under U.S. patent law and all foreign patent law with which Applicants' Representative is familiar. In other words, the Examiner is not free to define claim terms and phrases in ways that would give those terms and phrases meanings different from the meanings well-known to those ordinarily skilled in the art, or different from definitions of those terms and phrases in the specification. Applicants' Representative respectively refers the Examiner to MPEP § 2111 for a full discussion of this issue.

Although the term "logical device unit" was previously used in the

claims, with a very reasonable and well-understood meaning, Applicants' representative has amended the claims to replace the term "logical device unit" with the equivalent term "logical unit," which is quite specifically defined on page 3 of the current application. While reading the term "logical device unit" onto completely unrelated devices and entities, including relational databases and files, was unjustified in light of the specification and common understanding of the term, reading the term "logical unit" onto anything other than its well understood meaning, consistent with the definition provided in the specification, would be unquestionably improper.

Next, please consider amended claim 1, provided below:

1. A method for backing up a computer-readable object stored on a first logical unit of a mass-storage device, the method comprising:

when the object is not currently mirrored to a mass storage device, creating a mirror for the object on a second logical unit of the mass-storage device;

when the object and the mirror for the object are split, resyncing the object with the mirror for the object;

splitting the object and the mirror for the object so that the mirror becomes a backup copy of the object and so that I/O requests directed to the object are not automatically directed to the mirror;

retrieving a first instance of a current timestamp associated, by the mass-storage device, with the second logical unit and saving it as a saved timestamp;

updating, by the mass-storage device, the current timestamp associated with the second logical unit upon executing any I/O operation directed to the second logical unit that alters data stored on the second logical unit; and

when the object is determined to need to be restored from the mirror,

retrieving a second instance of the current timestamp associated with the second logical unit;

comparing the retrieved second instance of the current timestamp associated with the second logical unit to the saved timestamp; and

when the second instance of the current timestamp associated with the second logical unit is equal to the saved timestamp, copying the mirror to the first logical unit.

This claim is directed to a method by which a mass-storage device can quickly and efficiently ascertain whether a backup copy of an object, created by splitting a mirror pair, has been potentially altered since the mirror split. In this method, the mass-storage device associates a time stamp with each logical unit provided by the mass-storage device. When the mass-storage device directs a WRITE operation, or any other type of operation that could potentially alter data stored on the logical unit, to the logical unit, the mass-storage device updates the time stamp. The time stamp, like

a simple counter used in alternative embodiments claimed in subsequent claims, can only increase in value. Therefore, by saving a copy of the current value of a time stamp associated with a logical device, the mass-storage device can later compare the saved copy to the current value of the time stamp associated with the logical unit in order to determine whether or not any WRITE operations, or other operations that can modify data on a logical unit, have been directed to the logical unit. When the saved copy of the time stamp is identical to the current time stamp associated with the logical device at some subsequent point in time, the mass-storage device is assured that the data stored on the logical unit has not been altered since the saved time stamp was saved.

Comments by the Examiner in the Office Action lead Applicants' Representative to believe that the Examiner has not fully appreciated the currently claimed invention. First, Applicants' Representative would like to point out that mirroring of logical units in mass-storage devices, such as disk arrays, is an exceedingly well-known and well-developed technology. Mirroring is also used, at higher levels, in database management systems and other computer systems. Mirrored logical units are kept in lock-step synchronicity with respect to data modification, so that if one logical unit of a mirror fails, the other logical unit can be relied on to reflect all data modifications from the point in time that the logical units were joined in a mirror up until a logical-unit failure. In normal usage, mirroring refers to a dynamic condition in which updates to a logical unit, database, or data object are sent to two or more logical-unit, database, or data-object components of a mirrored logical unit, database, or data object.

Mirroring is commonly used in tandem with backup and restore procedures. When one logical-unit or data-object component of a mirrored logical unit or mirrored data object fails, the surviving logical unit or data object is generally immediately taken off line, and the contents of the surviving logical unit or data object are stored on a reliable, backup storage device. In general, backup storage devices are different from logical units and data objects. In general, backup devices are slower and cheaper, because data stored on backup devices need be retrieved only when all components of a mirror fail. Following backup, the contents of the surviving data object or logical unit are copied to a new data object or logical unit, and the surviving data object or logical unit and the new data object or logical unit are joined together in a new mirrored data object or logical unit.

Mirroring a data object or logical unit is not at all equivalent to backing up a data object or logical unit. A backup is a static snapshot of the contents of a data object, logical unit, or database made at some point in time. A backup can be used to restore a data object, database, or logical unit should that data object, database, or logical unit fail. However, upon restoration from the backup, the data object, database, or logical unit is restored to the state that the data object, database, or logical unit had at the time that the backup copy was created. By contrast, mirroring is used to keep data stored in two or more mirrored data objects, logical units, or databases synchronous as the data content of the data objects, logical units, or databases are modified. Mirroring is generally a dynamic, ongoing, real-time operation, while a backup is static, discrete operation used to produce a static image of the contents of a data object, logical unit, or database at a specified point in time.

The currently claimed method is a method for backing up a computer-readable object by a non-standard use of the mirroring facility of a mass-storage device. Rather than copying the computer-readable object to a backup medium, the mass-storage device employs efficient mirroring technology to create two or more copies of the computer-readable object within a mirror, and then splits the mirror to produce a backup copy of the computer-readable object. Unfortunately, currently available mass-storage devices have no efficient means for monitoring the backup copy created by the mirror split to ensure that the backup copy is not subsequently altered, because, in the case of logical units, logical units are not generally used as backup devices, and are accessible by remote host computers for ongoing use. If the mass-storage device splits a logical-unit mirror, intending to use the second logical unit as a backup of the first logical unit, the mass-storage device must ensure that a host computer does not subsequently direct a WRITE operation to the second logical unit. In currently available mass-storage devices, there is no means for the mass-storage device to monitor the second logical-device unit, used as a backup, to ensure that data stored in the second logical-device unit is not altered.

Time stamps are also well known in database management systems, electronic communications, and even operating systems. Time stamps are data that are associated with other data in order to keep track of the sequence of modifications of the other data. For example, data representing alterations to the contents of a database within event logs and recovery logs are normally associated with time stamps, so that stored alterations can be applied to the database in the time stamp

order, or so that stored, already applied alterations can be rolled back, or removed from the database, in reverse time stamp order.

In the claimed method, a mass-storage device associates a single, current time stamp with each logical unit provided by the mass-storage device. The mass-storage device updates the time stamp when the mass-storage device directs a data-altering command to the logical unit. Although time stamps and counters are well known in computer science, Applicants' Representative can think of no prior-art mass-storage device in which time stamps or counters are associated with logical units in order to subsequently determine whether the data stored on the devices has been altered. In other words, although time stamps and counters are well known in computer science, the method claimed in claim 1 employs time stamps, and subsequently claimed embodiments employ counters, in a novel manner.

In short, the currently claim method employs a non-standard use of mirroring to produce a backup copy of a computer-readable object, and employs a novel association of time stamps with logical units within a mass-storage device in order to monitor the backup logical unit to ensure that data stored on backup logical unit is not subsequently modified.

The Examiner cites five different references in various combinations in the above-listed obviousness-type rejections. Applicants' representative next discusses the two main references, Sparks and Beier. Sparks teaches a system in which a CPU is coupled to primary controller. The primary controller is, in turn, coupled by separate logical busses to several mass-storage devices and to several backup controllers, each backup controller in turn connected to a backup device. This architecture is clearly shown in Figure 2 of Sparks. Sparks' described system uses logical bus protocols to direct data from the CPU to mirrored storage devices (4A and 4B in Figure 2) during normal operation, or from a storage device to a backup device (6 in Figure 2) during a backup operation. Thus, Sparks simply teaches a hardware switch for transitioning between normal data-storage operations directed to mirrored storage devices and backup operations directed to backup devices. As Applicants' Representative has previously stated, Sparks is unrelated to the currently claimed invention. Sparks, for example, neither teaches nor mentions use of one logical unit of a pair of mirrored logical units as a backup, and neither teaches nor suggests monitoring a logical unit used as a backup for subsequent alteration of the contents of the logical unit. Sparks merely provides a protocol for switching between a standard

use of storage devices in a mirror pair and backing up the contents of a data-storage device to a backup device (e.g., a reel-to-reel tape drive, cartridge tape drive, or optical storage system). (Sparks, column 1, line 65 to column 2, line 45)

Beier, by contrast, is directed to synchronization of recovery logs for recovering contents-related, but different databases (Beier, Abstract). The error recovery logs are maintained separately by each database management system. As described beginning on line 37 of column 8 of Beier, a recovery log includes multiple entries, each entry including a time stamp. A data-base management system generally continuously adds a time stamp-containing entry to the recovery log each time the database management system executes a database transaction. Beier's described method, beginning on line 64 of column 8 and continuing to line 18 of column 9, involves using recovery logs to update a primary database for each of two different types of databases, but only recovery-log information for relational database that has time stamps less than the time stamp associated with the last log entry for a hierarchical database is used for restoring the primary databases. Time stamps associated with error-log entries and database management systems have been well known and commercially available for at least 25 years. Note, however, that Beier does not discuss or mention logical units, time stamps associated with logical units, time stamps associated with any physical device, or anything else related to Applicants' claimed invention. In the Response to Arguments section of the Office Action, the Examiner disagreed with Applicants' Representative's analysis of Beier, maintaining that the association between time stamps with logical units and physical devices are not in the claims. However, association of time stamps with logical units is clearly claimed in claim 1, and in the other independent claims. Applicants' Representative has amended the independent claims to even more clearly point out the association of time stamps and counters with logical units, but that association was clearly claimed in prior versions of the claims as well. Beier simply teaches a relatively standard use of time stamps and error recovery logs of a database system. In this application, the time stamps are associated with data, not with logical units, or any other physical device.

Next, please consider the first 35 U.S.C. § 103(a) rejection of claims 1-12 and 20-25 in Section 4 of the Office Action. The Examiner states that Sparks teaches "splitting the object and the mirror for the object so that the mirror becomes a backup copy of the object and so that I/O requests directed to the object are not

automatically directed to the mirror” on lines 46-52 of column 3. Sparks teaches nothing at all related to splitting a mirror and using one data-storage device of a pair of mirrored data-storage devices as a backup copy. The cited passage in Sparks refers to the fact that, if more than two data-storage devices are together mirrored, a backup operation may be undertaken between one of the data-storage devices of the mirror concurrently with continued mirroring of the remaining data-storage devices. In the backup operation, data is copied from a data-storage device to a backup device, while normal mirrored WRITE operations continue to be directed to at least two remaining data-storage devices of the mirror. In other words, Sparks clearly teaches using specialized backup devices for backups and storage devices as components of mirrors. Sparks does not suggest employing a mirror component as a backup device. The Examiner has incorrectly attributed the non-standard use of a mirror pair for creating a backup copy, claimed in the current claims, to a very well-known, standard usage of mirrors and backup devices disclosed by Sparks.

Then, the Examiner provides a lengthy discussion of Beier, finally concluding that Beier “teaches the updating the time stamp and the time stamp comparison process to restore the file.” In fact, as discussed above, Beier discloses a very standard use of time stamps for serializing recovery log entries. The Examiner then states that “[t]herefore, it would have been obvious to one ordinary skill in the art at the time of the invention was made to modify updating the time stamp and utilizing the time stamp comparison process of Beier into Sparks in order to restore the data in the most current state.” Sparks teaches or mentions nothing about restoring data in the most current state. Beier teaches or suggests nothing concerned with associating time stamps with logical units in a mass-storage device. There is no basis for proposing a combination of Beier, a straightforward application of time stamps in database error recovery logs, and Sparks, disclosing a traditional and well-known use of mirrors and backups with absolutely no mention of a need to monitor backup integrity using timestamps or any other mechanism. The suggested combination would produce a recovery log technique combined with standard data storage and backup methods, a combination completely unrelated to the claimed invention and lacking any purpose.

The Examiner then proceeds to draw a number of additional incorrect conclusions with regard to Sparks and Beier apparently based on a misreading of Sparks and Beier. For example, the Examiner states that “Sparks teaches including

copying the object to a second backup copy on a difficult-to-modify mass-storage device after splitting the object and the mirror for the object” on lines 30-34 of column 3. The cited lines of Sparks do not mention an object, a second backup copy, splitting an object, or a mirror. Instead, the cited lines of Sparks relate to the fact that, in traditional architectures, the primary controller is dedicated either to storing data received from a CPU onto primary data-storage devices or copying data from primary data-storage devices to a backup device. The cited portion of Sparks has nothing at all to do with "copying the object to a second backup copy on a difficult-to-modify mass-storage device after splitting the object and the mirror for the object.” Next, the Examiner claims that Beier teaches, on lines 24-51 of column 7, “when the second instance of the current time stamp is not equal to the saved time stamp, copying the second backup copy from the difficult-to-modify mass-storage device to the first logical unit to replace (copy means replace) or again create the object on the first logical unit.” Applicants’ Representative has carefully read the cited section of Beier, and can find not one occurrence of the word “timestamp,” the term “saved timestamp,” the phrase “logical unit,” or, indeed, anything at all to do with claims 3 and 22. Instead, the cited section of Beier has to do with updating records and transaction-log files within a database management system.

Next, the Examiner states that Sparks “teaches the second logical unit spans one or more hard drive disks and the difficult-to-modify mass storage device is a tape drive,” on column 3, lines 30-34. Lines 30-34 have already been discussed. They include absolutely no reference to logical units, hard-disk drives, or spanning of hard-disk drives by logical units. The cited portion of Sparks has nothing at all to do with claims 4 and 23. Next, the Examiner states that Beier teaches “the first and second logical units are provided by one or more disk array controllers, wherein data stored to the first and second logical units are stored by the one or more disk array controllers on one or more hard-disk drives, and wherein the one or more disk array controllers provide time stamps to requesting applications and systems and update the time stamp associated with a logical unit upon executing I/O operations directed to the logical unit that alters data stored on the logical device” on lines 64-67 of column 8 and lines 1-18 of column 9. Again, Applicants’ Representative has carefully read the cited portions of Beier and can find no mention of the term “disk array controller,” “logical unit,” “hard-disk drives,” “requesting applications,” or anything else with any relation to claims 5 and 6. The cited portion of Beier discusses standard relational

database log entries and hierarchical database log records, both of which include time stamps. This is a very standard and well-known use of time stamps that is completely unrelated to the claimed invention.

In subsequent 35 U.S.C. § 103(a) rejections, the Examiner relies on Carter in combination with Beier, rather than Sparks in combination with Beier. Again, however, the Examiner has completely misinterpreted Carter, or has misconstrued claim terms and read misconstrued claim terms on completely unrelated teachings within Carter. As one example, the Examiner cites Carter as teaching “the controller updating the current state metric for a logical unit whenever the controller executes an I/O operation that changes the data (stored file metadata, such as the file time stamps and the file size, can be updated quite frequently, making the metadata update more expensive)” on lines 46-49 of column 10. The cited portion of Carter is related to directory-entry scanning by user applications. (Carter, column 10, lines 37-38) The cited portion discusses a problem in scanning directory entries related to doubly stored file metadata within Windows NT file system files. The claim language for which this passage is cited involves updating a current state metric, such as a time stamp or counter, by the controller of a mass-storage device when the controller directs an I/O operation to the logical unit. The cited passage has nothing to do with mass-storage device controllers, logical units, direction of I/O requests to logical units by a controller within a mass-storage device, or anything at all related to the current invention or anything taught or discussed in the current application. Carter is generally related to a distributed data-storage system which tolerates node failures. There is no mention in Carter of a method for using a mirror facility within a mass-storage device to create a backup, no mention of a method for ensuring that the backup is not subsequently altered, and no mention of association of time stamps or counters with logical units within a mass-storage device. Carter is as completely unrelated to the current application as Sparks. Because Beier teaches nothing more than a standard use of time stamps in error recovery logs of database management systems, there is simply no grounds for combining Beier and Carter, and no possibility that Carter, Beier, or Beier and Carter in combination teach, mention, or suggest anything at all related to the currently claimed invention.

Applicants’ Representative respectfully urges the Examiner to carefully re-read the current application and current claims in order to understand the terms and phrases used in the current claims in light of the specification of the current

application and the well-understood meaning of these terms and phrase in the art. The Examiner, as discussed above, cannot simply define and use terms and phrases to have meanings unrelated to the meanings of these terms and phrases as used in the current specification and as ordinarily understood by those skilled in the art, and then read the misconstrued claims based upon erroneous definitions onto completely unrelated teachings. In the Office Action, the Examiner has apparently not even bothered to provide a mapping between well-understood terms, such as "disk-array controller" and "logical unit" and whatever unrelated terms in cited passages of Sparks and Beier that the Examiner feels these terms read on.

In summary, the currently claim method employs a non-standard use of mirroring to produce a backup copy of a computer-readable object, and employs a novel association of time stamps with logical units within a mass-storage device in order to monitor the backup logical unit to ensure that data stored on backup logical unit is not subsequently modified. The references cited by the Examiner are completely unrelated to the currently claimed invention. The cited references neither teach nor suggest use of a mirror component as a backup device following a mirror split, association of a timestamp or counter with logical units within a mass storage device for any reason, monitoring of a logical unit used as a backup for modification of the data stored within the logical component, or any other aspect of the currently claimed invention. Passages of cited references specifically cited by the Examiner are generally unrelated to the propositions for which they are cited, fail to contain or discuss related terms or concepts, and bear no meaningful relation to claim language against which they are recited.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

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